

PROFESSIONAL RESUME

Edward A. Berry

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A. EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	YEAR(s)	FIELD OF STUDY
College of Charleston, S.C.	B.S.	1974	Biology
Cornell University	Ph.D.	1981	Biochemistry
Dartmouth Medical School	Postdoctoral	1981-1984	Biochemistry
Univ. of Illinois (Urbana-Champaign)	Postdoctoral	1984-1987	Biophysics

B. POSITIONS AND HONORS.

Positions and Employment

1987 – present Staff Scientist II, Lawrence Berkeley Laboratory, University of California at Berkeley.

Honors

2007 (-2009) Selected Mentor, Pew Latin Postdoctoral Fellow Julio Lenin Domínguez-Ramírez
Feb. 2006 Co-chair, platform session on electron transport, Biophysical Society Annual meeting, Salt Lake City, Utah, USA, Feb 18-24 2006.

2006-2009 Elected Council member, Biophysical Society Bioenergetics subcommittee
April 2006 Outside thesis committee member, Univ. of Illinois/U-C, Cesar Luna-Chavez
Dec 2005 Invited speaker at Bioenergetics Symposium, Bari Italy 17-22 December 2005
June 2005 Invited speaker at Gordon Research Conference on cellular bioenergetics
Mar 10 2005 NIH Study Section Member, Special Emphasis Panel/Scientific Review Groups 2005/05 ZRG1 BCMB-B (02/03) (M)

July 16 2004 NIH Study Section Member, Special Emphasis Panel/Initial Review Group 2004/10 ZRG1 BPC-B (02) (M),

Feb. 2004 Organizer and co-chair of Biophysical Society Bioenergetics Subgroup Symposium "Structural Biology Of Photosynthesis" February 14-18, 2004 Baltimore, Maryland, USA

August 2003 Invited speaker at Nobel Symposium 126 "Membrane Proteins: Structure, Functions, And Assembly" August 22-24, Friiberghs Herrgård, Sweden

Nov-Dec 2002 Recipient of Fellowship from French Ministry of Youth, Education, and Research for investigations at the Institut de Biologie Physico-Chimique, Paris France

June 2001 Thesis examiner, Uppsala University, for Momi Iwata's thesis defense
Sept 9-14 2000 Organizer and Chairperson of European Bioenergetics Congress Symposium "Cytochrome bc complexes" Brighton, UK.

Feb. 12, 2000 Organizer and co-chair of Biophysical Society Bioenergetics Subgroup Symposium "Three-dimensional structure determination: Cytochrome bc1 and b6f complexes" New Orleans, Louisiana, USA

June 17-28, 1998 Instructor at EMBO Practical course "Current Methods in Membrane Protein Research", EMBL, Heidelberg

C. Selected peer-reviewed publications (in chronological order).

1. Berry, E.A. and Hinkle, P.C. (1983) Measurement of the Electrochemical Proton Gradient in Submitochondrial Particles. **J. Biol. Chem.**, **258**, 1474-1486.
2. Berry, E.A. and Trumpower, B.L. (1985) Pathways of Electrons and Protons Through the Cytochrome bc₁ complex of the Mitochondrial Respiratory Chain. In "**Coenzyme Q**" (G. Lenaz, Ed.), Wiley & Sons, 365-389.
3. Berry, E.A. and Trumpower, B.L. (1985) Isolation of Ubiquinol Oxidase from *Paracoccus denitrificans* and Resolution into Cytochrome bc₁ and Cytochrome c-aa₃ Complexes. **J. Biol. Chem.** **260**, 2458-2467.
4. Berry, E.A. and Trumpower, B.L. (1987) Simultaneous Determination of Hemes a, b, and c from Pyridine Hemochrome Spectra. **Anal. Biochem.** **161**, 1-15
5. Crofts, A., Robinson, H., Andrews, K., van Doren, S., and Berry, E. (1988) Catalytic Sites for Reduction and Oxidation of Quinones. In **Cytochrome Systems**, (Papa, S. et al. eds.) Plenum Press, N.Y. pp. 617-624.
6. Huang, L.-s. and Berry, E.A. (1990) Purification and Characterization of the Proton Translocating Plasma Membrane ATPase of Red Beet Storage Tissue. **Biochim. Biophys. Acta** **1039**, 241-252.
7. Berry, E.A., Huang, L.-s. and DeRose, V. (1991) Ubiquinol-Cytochrome c Oxidoreductase of Higher Plants. Isolation and Characterization of the bc₁ Complex from Potato Tuber Mitochondria. **J. Biol. Chem.** **266**, 9064-9077.
8. Berry, E.A., Huang, L.-S., Earnest, T.N. and Jap, B.K. (1992) X-ray Diffraction by Crystals of Beef Heart Ubiquinol:Cytochrome c Oxidoreductase. **J. Mol. Biol.** **224**, 1161-1166
9. Garcia-Horsman, J.A., Berry, E., Shapleigh, J.P., Alben, J.O., and Gennis, R.B. (1994) A Novel Cytochrome c Oxidase from *Rhodobacter sphaeroides* that Lacks Cu_A. **Biochemistry** **33**, 3113-3119.
10. Berry E.A.; Shulmeister VM; Huang LS; Kim SH. (1995) A new crystal form of bovine heart ubiquinol:cytochrome c oxidoreductase - determination of space group and unit-cell parameters. **Acta Crystallographica D**: **51**, 235-239.
11. Zhang, Z., Huang, L.-S., Shulmeister, V.M., Chi, Y.I., Kim, K.K., Hung, L.-W., Crofts, A.R., Berry, E.A., and Kim, S.-H. (1998) Electron transfer by domain movement in cytochrome bc₁. **Nature** **392**, 677-684.
12. Crofts AR, Berry EA. (1998) Structure and function of the cytochrome bc₁ complex of mitochondria and photosynthetic bacteria. **Curr. Opin. Struct. Biol.** **8**, 501-509
13. Crofts AR, Hong S, Ugulava N, Barquera B, Gennis R, Guergova-Kuras M, Berry EA (1999) Pathways for proton release during ubihydroquinone oxidation by the bc₁(1) complex. **Proc Natl Acad Sci U S A** **96**, 10021-10026
14. Berry E.A., Zhang Z., Huang L.S., and Kim S.H. (1999) Structures of Quinone binding sites in bc complexes: Functional implications **Biochem. Soc. Transactions** **27**, 565-572.
15. Berry E.A., Huang L.S., Zhang Z., and Kim S.H. (1999) The Structure of the Avian Mitochondrial Cytochrome bc₁ Complex. **J. Bioen. Biomemb.** **31**, 177-190.
16. Crofts AR, Hong S, Zhang Z and Berry EA (1999) Physicochemical aspects of the movement of the Rieske iron sulfur protein during quinol oxidation by the bc₁ complex from mitochondria and photosynthetic bacteria. **Biochemistry** **38**; 15827-15839.
17. Horvath A, Berry EA, Maslov DA (2000) Translation of the edited mRNA for cytochrome b in trypanosome mitochondria. **Science** **287**, 1639-40
18. McFadden DC, Tomavo S, Berry EA, Boothroyd JC (2000) Characterization of cytochrome b from *Toxoplasma gondii* and Q(o) domain mutations as a mechanism of atovaquone-resistance. **Mol Biochem Parasitol** **108**(1):1-12

19. Chi Y-I, Huang L-S, Zhang Z, Fernández-Velasco JG and Berry EA (2000) X-Ray Structure of a Truncated Form of Cytochrome *f* from *Chlamydomonas reinhardtii*. **Biochemistry** **39**:7689-701
20. Edward A. Berry, E.A., Zhang, Z., Bellamy, H.D., and Huang, L.-S. (2000) Crystallographic location of two Zn²⁺-binding sites in the avian cytochrome bc₁ complex. **Biochimica et Biophysica Acta** **1459**, 440-448
21. Berry EA, Guergova-Kuras M, Huang L.-S., Crofts AR (2000) Structure And Function Of Cytochrome bc Complexes. **Annu Rev Biochem** **69**:1005-1075
22. Horvath A, Berry EA, Huang L.-S., Maslov D.A. (2000) Leishmania tarentolae: A Parallel Isolation of Cytochrome bc(1) and Cytochrome c Oxidase. **Exp Parasitol** **96**(3):160-167
23. Lee SY, Cho HS, Pelton JG, Yan D, Henderson RK, King DS, Huang L, Kustu S, Berry EA, Wemmer DE. (2001) Crystal structure of an activated response regulator bound to its target. **Nat Struct Biol** **8**:52-56
24. Meshnick S R, Berry E A, Nett J, Kazanjian P, Trumpower B.(2001) The interaction of atovaquone with the *P. carinii* cytochrome **bc**₁ complex. **J Eukaryot Microbiol** **2001**;Suppl:169S-171S .
25. Cobessi D, Huang LS, Ban M, Pon NG, Daldal F, Berry EA. (2002) The 2.6 Å resolution structure of Rhodobacter capsulatus bacterioferritin with metal-free dinuclear site and heme iron in a crystallographic 'special position'. **Acta Crystallogr D Biol Crystallogr** **58**(Pt 1):29-38
26. Huang, L.-S., Cobessi, D., and Berry, E.A. (2003) Crystallization of the Cytochrome bc₁ complex. in **"Methods and Results in Membrane Protein Crystallization"** (S. Iwata, Ed) pp. 203-226, IUL press, La Jolla.
27. Popot, J.-L., Berry, E.A., Charvolin, D., Creuzenet, C., Ebel, C, Engelman, D.M., Flötenmeyer, M., Giusti, F., Gohon, Y., Hervé, P., Hong, Q., Lakey, J.H., Leonard, K., Shuman, H.A., Timmins, P, Warschawski, D.E., Zito, F., Zoonens, M., Pucci, B. and Tribet, C. (2003) Amphipols: polymeric surfactants for membrane biology research. **Cell. Mol. Life Sci.** **60**, 1559-74
28. Kolling, D.R.J., Samoilova, R.I., Holland, J. T., Berry, E.A., Dikanov, S.A. , and Crofts, A.R. (2003) Exploration of ligands to the Qi-site semiquinone in the bc₁ complex using high resolution EPR. **J. Biol. Chem.** **278**:39747-54
29. Berry E.A. and Huang L.S. (2003) Observations concerning the quinol oxidation site of the cytochrome bc₁ complex. **FEBS Lett** **555**: 13-20
30. Bowman, M.K., Berry, E.A., Roberts, A.G., and Kramer, D.M. (2004) Orientation of the g-Factor Axes of the Rieske Subunit in Cytochrome bc₁ Complex **Biochemistry** **43**:430-436.
31. Berry E.A., Huang L.-S., Saechao L.K., Pon N.G., Valkova-Valchanova M. and Daldal F. (2004) X-Ray Structure of Rhodobacter Capsulatus Cytochrome bc₁: Comparison with its Mitochondrial and Chloroplast Counterparts. **Photosynthesis Research** **81**: 251-275
32. Huang, L.-S., Borders, T. M., Shen, J. T., Wang, C.-J., and Berry, E. A. (2005) Crystallization of Mitochondrial Respiratory Complex II from Chicken Heart: a Membrane Protein Complex Diffracting to 2.0 Å. **Biological Cryst.** (Acta Cryst.) **D61**, 380-387.
33. Huang, L.-S., Cobessi, D., Tung, E.Y., Berry, E.A.(2005) Binding Of The Respiratory Chain Inhibitor Antimycin To The Mitochondrial bc₁ Complex: A New Crystal Structure Reveals An Altered Intramolecular Hydrogen-Bonding Pattern. **J. Mol. Biol.** **351**, 573-97
34. Huang, L.-S., Sun, G., Cobessi, D., Wang, A., Shen, J.T., Tung, E.Y., Anderson, V.E., Berry, E.A. (2006) 3-Nitropropionic acid is a suicide inhibitor of mitochondrial respiration that, upon oxidation by Complex II, forms a covalent adduct with a catalytic-base arginine in the active site of the enzyme. **J. Biol. Chem.** **281**, 5965-5972.
35. Huang, L.-S., Shen, J.T., Wang, A.C., Berry, E.A. (2006) Crystallographic studies of the binding of ligands to the dicarboxylate site of Complex II, and the identity of the ligand in the "oxalacetate-inhibited" state. **Biophys. Biochim. Acta - Bioenergetics** **1757** 1073–1083
36. Devanathan S., Salamon Z., Tollin G., Fitch J. C., Meyer T. E., Berry E. A., and Cusanovich M. A. (2007) Plasmon Waveguide Resonance Spectroscopic Evidence for Differential Binding of Oxidized and

Reduced *Rhodobacter capsulatus* Cytochrome c_2 to the Cytochrome bc_1 Complex Mediated by the Conformation of the Rieske Iron-Sulfur Protein. **Biochemistry**;46(24):7138-45.

37. Giachini, L., Francia, F., Veronesi, G., Lee, D-W, Daldal, F., Huang, L.-S., Berry, E.A., Cocco, T., Papa, S., Federico Boscherini II, F., Venturoli, G. (2007) X-ray absorption studies of Zn^{2+} binding sites in bacterial, avian and bovine cytochrome bc_1 complexes. **Biophys. J.** (In Press; published on June 15, 2007 as doi:10.1529/biophysj.107.110957)
38. Berry, EA, Lee, D-W, Huang, L.-S., Daldal, F. (2007) Structural and Mutational Studies of the Cytochrome bc_1 Complexes in **The Purple Photosynthetic Bacteria** (Hunter NC, Daldal F, Thurnauer MC, and Beatty TJ, eds) (Invited paper).

D. Structures solved and deposited with the PDB.

PDB ID	Date	Resolution	Number of Reflns	Rcryst	Rfree
1bcc	23-Mar-98	3.16	107167	0.27	0.31
	Cytochrome bc_1 Complex From Chicken				
2bcc	18-Sep-98	3.50	80760	0.284	0.317
	Stigmatellin-Bound Cytochrome bc_1 Complex From Chicken				
3bcc	23-Mar-98	3.70	71026	0.289	0.321
	Stigmatellin And Antimycin Bound Cytochrome bc_1 Complex From Chicken				
1cfm	18-Sep-98	2.00	46907	0.214	0.271
	Cytochrome f From <i>Chlamydomonas Reinhardtii</i>				
1jgc	24-Jun-01	2.60	22526	0.225	0.242
	The 2.6 Å Structure Resolution Of <i>Rhodobacter Capsulatus</i> Bacterioferritin With Metal-Free Dinuclear Site And Heme Iron In A Crystallographic Special Position				
1pp9	16-Jun-03	2.10	305496	0.250	0.287
	Bovine Cytochrome bc_1 Complex With Stigmatellin Bound				
1ppj	16-Jun-03	2.10	285060	0.224	0.260
	Bovine Cytochrome bc_1 Complex With Stigmatellin And Antimycin				
1yq3	01-Feb-05	2.20	78719	0.175	0.223
	Avian Respiratory Complex II With Oxaloacetate And Ubiquinone				
1yq4	01-Feb-05	2.33	68868	0.202	0.252
	Avian Respiratory Complex II With 3-Nitropropionate And Ubiquinone				
1zrt	22-May-05	3.50	33265	0.300	0.358
	<i>Rhodobacter capsulatus</i> Cytochrome bc_1 Complex With Stigmatellin Bound				
2a06	16-Jun-05	2.10	276810	0.222	0.258
	Bovine Cytochrome bc_1 Complex With Stigmatellin Bound				
2fbw	10-Dec-05	2.10	162208	0.187	0.227
	Avian Respiratory Complex II With Carboxin Bound				
2h88	06-Jun-06	1.74	291095	0.178	0.206
	Avian Mitochondrial Respiratory Complex II At 1.8 Å Resolution				
2h89	06-Jun-06	2.40	59635	0.226	0.279
	Avian Respiratory Complex II With Malonate Bound				

E. Recent publication highlights

Berry E.A. and Huang L.S. (2003) Observations concerning the quinol oxidation site of the cytochrome bc₁ complex. **FEBS Lett** **555**: 13-20

Abstract: A direct hydrogen bond between ubiquinone/quinol bound at the QO site and a cluster-ligand histidine of the iron-sulfur protein (ISP) is described as a major determining factor explaining much experimental data on position of the ISP ectodomain, electron paramagnetic resonance (EPR) lineshape and midpoint potential of the iron-sulfur cluster, and the mechanism of the bifurcated electron transfer from ubiquinol to the high and low potential chains of the bc₁ complex.

Berry E.A., Huang L.-S., Saechao L.K., Pon N.G., Valkova-Valchanova M. and Daldal F. (2004) X-Ray Structure of Rhodobacter Capsulatus Cytochrome bc₁: Comparison with its Mitochondrial and Chloroplast Counterparts. **Photosynthesis Research** **81**: 251-275

Abstract: Ubihydroquinone: cytochrome (cyt)c oxidoreductase, or cyt bc₁, is a widespread, membrane integral enzyme that plays a crucial role during photosynthesis and respiration. It is one of the major contributors of the electrochemical proton gradient, which is subsequently used for ATP synthesis. The simplest form of the cyt bc₁ is found in bacteria, and it contains only the three ubiquitously conserved catalytic subunits: the Fe-S protein, cyt b and cyt c₁. Here we present a preliminary X-ray structure of Rhodobacter capsulatus cyt bc₁ at 3.8 Å and compare it to the available structures of its homologues from mitochondria and chloroplast. Using the bacterial enzyme structure, we highlight the structural similarities and differences that are found among the three catalytic subunits between the members of this family of enzymes. In addition, we discuss the locations of currently known critical mutations, and their implications in terms of the cyt bc₁ catalysis.

Huang, L.-S., Borders, T. M., Shen, J. T., Wang, C.-J., and Berry, E. A. (2005) Crystallization of Mitochondrial Respiratory Complex II from Chicken Heart: a Membrane Protein Complex Diffracting to 2.0 Å. **Biological Cryst. (Acta Cryst.) D61**, 380-387.

Abstract: A procedure is presented for preparation of diffraction-quality crystals of a vertebrate mitochondrial respiratory complex II. The crystals have the potential to diffract to at least 2.0 Å with optimization of post-crystal-growth treatment and cryoprotection. This should allow determination of the structure of this important and medically relevant membrane-protein complex at near-atomic resolution and provide great detail of the mode of binding of substrates and inhibitors at the two substrate-binding sites.

Huang, L.-S., Cobessi, D., Tung, E.Y., Berry, E.A. (2005) Binding Of The Respiratory Chain Inhibitor Antimycin To The Mitochondrial bc₁ Complex: A New Crystal Structure Reveals An Altered Intramolecular Hydrogen-Bonding Pattern. **J. Mol. Biol.** **351**, 573-97

Abstract: Antimycin A (antimycin), one of the first known and most potent inhibitors of the mitochondrial respiratory chain, binds to the quinone reduction site of the cytochrome bc₁ complex. Structure–activity relationship studies have shown that the N-formylamino-salicyl-amide group is responsible for most of the binding specificity, and suggested that a low pK_a for the phenolic OH group and an intramolecular H-bond between that OH and the carbonyl O of the salicylamide linkage are important. Two previous X-ray structures of antimycin bound to vertebrate bc₁ complex gave conflicting results.

A new structure reported here of the bovine mitochondrial bc₁ complex at 2.28 Å resolution with antimycin bound, allows us for the first time to reliably describe the binding of antimycin and shows that the intramolecular hydrogen bond described in solution and in the small-molecule structure is replaced by one involving the NH rather than carbonyl O of the amide linkage, with rotation of the amide group relative to the aromatic ring. The phenolic OH and formylamino N form H-bonds with conserved Asp228 of cytochrome b, and the formylamino O H-bonds via a water molecule to Lys227. A strong density, the right size and shape for a diatomic molecule is found between the other side of the dilactone ring and the aA helix.

Huang, L.-S., Sun, G., Cobessi, D., Wang, A., Shen, J.T., Tung, E.Y., Anderson, V.E., Berry, E.A. (2006) 3-Nitropropionic acid is a suicide inhibitor of mitochondrial respiration that, upon oxidation by Complex II, forms a covalent adduct with a catalytic-base arginine in the active site of the enzyme. **J. Biol. Chem.** **281**, 5965-5972.

Abstract: We report three new structures of mitochondrial respiratory Complex II (succinate ubiquinone oxidoreductase, E.C.1.3.5.1) at up to 2.1 Å resolution, with various inhibitors. The structures define the conformation of the bound inhibitors and suggest the residues involved in substrate binding and catalysis at the dicarboxylate site.

In particular they support the role of Arg 297 as a general base catalyst accepting a proton in the dehydrogenation of succinate. The dicarboxylate ligand in oxaloacetate-containing crystals appears to be the same as that reported for *Shewanella flavocytochrome c* treated with fumarate. The plant and fungal toxin 3-nitropropionic acid, an irreversible inactivator of succinate dehydrogenase, forms a covalent adduct with the side chain of Arg 297. The modification eliminates a trypsin cleavage site in the flavoprotein, and tandem mass spectroscopic analysis of the new fragment shows the mass of Arg 297 to be increased by 83 Da and to have the potential of losing 44 Da, consistent with decarboxylation, during fragmentation.

F. Research Programs

Ongoing Research

DK44842 (Berry, Edward A.) 03/01/92-11/30/08

National Institute of Diabetes and Digestive and Kidney Diseases

3D Crystals of Cytochrome Reductase, A Membrane Protein

The goal of this project is to obtain structural information about the cytochrome reductase complex from the analysis of 3-dimensional crystals.

Role: P.I.; crystallography and structure determination.

GM62563 (Berry, Edward A.) 05/01/00-08/31/07.

National Institute of General Medical Sciences

3-D Crystal Structure: Vertebrate Mitochondrial Complex II

The goal: optimize crystallization of Complex II and from the crystals solve the structure with a variety of ligands at the active sites.

Role: P.I.; crystallography and structure determination.

Informal: Collaboration with Jean-Luc Popot's Membrane Protein Group

at the Institute of Biophysical Chemistry, Paris on developing amphipols as stabilizing agents for membrane proteins in solution.

Pending: Marie Curie Initial Training Networks (ITN) "Structural Biology of Membrane Proteins"

PI: Alain Milon

Role: Visiting Scientist

G. REFERENCES:

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